

WHAT IS CLAIMED IS:

1. A stereoscopic image display method for
permitting an observer to stereoscopically observe
image information displayed on an image display element
5 by dividing each of parallax images corresponding to a
plurality of different view points, into predetermined
stripe images, synthesizing a synthetic parallax image
from the stripe images, guiding display light from
stripe images corresponding to one view point in the
10 synthetic parallax image on the image display element
displaying the synthetic parallax image, to a mask
member having a mask pattern with predetermined
openings and shields by a second optical system placed
in front of the image display element, and converging
15 display light passing through the openings of the mask
member to a position corresponding to the view point on
an observation surface a predetermined distance apart,
by a first optical system.

20 2. The stereoscopic image display method
according to Claim 1, wherein among image display light
from pixels forming each stripe image, display light
reaching a position of an observer's view point
corresponding to the stripe image is condensed to the
25 mask member by the second optical system so as to pass
through the openings of the mask member and the other
light is intercepted by the shields.

3. The stereoscopic image display method according to Claim 1, wherein said second optical system forms images of pixels of said image display element on said mask member in the vertical direction and a position of a focal point thereof is approximately coincident with a position of the mask member in the horizontal direction.

4. The stereoscopic image display method according to Claim 1, wherein N view points (N is an integer not less than 2) are arranged at equal intervals on the observation surface the predetermined distance apart.

5. The stereoscopic image display method according to Claim 4, wherein said first optical system and second optical system have predetermined periodic structure in the horizontal direction and the second optical system or/and the image display element are placed on intersecting planes of many straight lines connecting two adjacent view points out of the N view points arranged at the equal intervals in the horizontal direction and a horizontal center of each elementary optical element forming the second optical system.

6. The stereoscopic image display method

according to Claim 1, wherein said second optical system has predetermined periodic structure in each of the horizontal and vertical directions and an elementary optical element forming one period in the horizontal and vertical directions has optical action in the horizontal direction and optical action in the vertical direction different from each other.

7. The stereoscopic image display method according to Claim 1, wherein intersecting points of many straight lines connecting two adjacent view points out of the N view points arranged at the equal intervals and a horizontal center of each elementary optical element forming said second optical system agree with horizontal centers of the respective elementary optical elements forming the second optical system or/and agree with horizontal centers of pixels forming the image display element.

8. The stereoscopic image display method according to Claim 1, wherein the following relations are met:

$$Nd \cdot HL1/E = Lhd / (Lhd + Lh0) \quad (h1)$$

$$Hd/HL1 = (Lh0 + Lhd) / Lh0 \quad (h2)$$

$$NL2 \cdot HL1/E = LhL2 / (LhL2 + Lh0) \quad (h3)$$

$$HL2/HL1 = (Lh0 + LhL2) / Lh0 \quad (h4)$$

$$H1/E = Lh1 / (Lh1 + Lh0) \quad (h5)$$

$$Hl/Hl1 = (Lh0 + Lhl)/Lh0 \quad (h6)$$

$$Hl * Lh1a/Lhl = Hl1 * Lh1b/Lhl \quad (h7)$$

$$Lh1a + Lh1b = Lhl \quad (h8)$$

$$Hm/Hl = Lh1a/Lhl \quad (h9)$$

5 where N view points (N is an integer not less than
2) are arranged at equal intervals E on the observation
surface the predetermined distance apart, HL1 is a
horizontal period of elementary optical elements
forming said first optical system, Hm a horizontal
10 width of the openings of said mask member, HL2 a
horizontal period of elementary optical elements
forming said second optical system, Hd a horizontal
pixel pitch of the image display element, LhL2 and Lhd
an optical reduced distance between the first optical
15 system and the second optical system and an optical
reduced distance between the first optical system and
the image display element, respectively, Lh0 an optical
reduced distance from the observation surface to the
first optical system, Lhl an optical reduced distance
20 from the first intersecting plane, when counted from
the first optical system toward the image display
element, out of intersecting planes of line groups
connecting two adjacent view points out of the N view
points and each pixel of the image display element, to
25 the first optical system, Lh1a and Lh1b an optical
reduced distance from the first optical system to the
mask member and an optical reduced distance from the

mask member to the first intersecting plane from the first optical system out of the intersecting planes, and N_d and N_{L2} integers not less than 2 ($N_d > N_{L2}$).

5 9. The stereoscopic image display method according to Claim 1, wherein relations of Eq. (V1N) to Eq. (V3N) or relations of Eq. (V1N) to Eq. (V4N) below are met:

$$V_d:V_m = LV_1:LV_2 \quad (V1N)$$

10 $2 \cdot N \cdot V_d:V_L = LV_1+LV_2 : LV_2 \quad (V2N)$

$$1/LV_1 + 1/LV_2 = 1/f_V \quad (V3N)$$

$$N \cdot V_d:V_L = LV_0+LV_1+LV_2 : LV_0+LV_2 \quad (V4N)$$

 where V_d is a vertical pixel pitch of said image display element, V_m a vertical width of the openings or
15 the shields of the mask pattern of said mask member, LV_1 an optical reduced distance from the image display element to a surface of the second optical system having optical action in the vertical direction, LV_2 an
20 optical reduced distance from the surface of the second optical system having the optical action in the vertical direction to the mask pattern, f_V a vertical focal length of individual elementary optical elements forming the second optical system, LV_0 an optical
25 reduced distance between the mask pattern and the observation surface, and N the number of view points (N is an integer not less than 3).

10. The stereoscopic image display method according to Claim 1, wherein relations of Eq. (V1) to Eq. (V3) or relations of Eq. (V1) to Eq. (V4) below are met:

$$\begin{aligned} 5 \quad & V_d:V_m = LV_1:LV_2 & (V1) \\ & 2 \cdot V_d:V_L = LV_1+LV_2 : LV_2 & (V2) \\ & 1/LV_1 + 1/LV_2 = 1/f_v & (V3) \\ & V_d:V_L = LV_0+LV_1+LV_2 : LV_0+LV_2 & (V4) \end{aligned}$$

where said number of view points is 2, V_d is a
10 vertical pixel pitch of said image display element, V_m
a vertical width of the openings or the shields of the
mask pattern of said mask member, LV_1 an optical
reduced distance from said image display element to a
surface of said second optical system having optical
15 action in the vertical direction, LV_2 an optical
reduced distance from the surface of the second optical
system having the optical action in the vertical
direction to the mask pattern, f_v a vertical focal
length of individual elementary optical elements
20 forming the second optical system, and LV_0 an optical
reduced distance between the mask pattern and the
observation surface.

11. The stereoscopic image display method
25 according to Claim 1, wherein said first and second
optical systems comprise microlens arrays.

12. The stereoscopic image display method according to Claim 1, wherein said first and second optical systems comprise lenticular lenses.

5 13. The stereoscopic image display method according to Claim 1, wherein said second optical system is comprised of a lenticular lens in which cylindrical lenses being long in the vertical direction and having an optical power only in the horizontal
10 direction are arranged at predetermined intervals in the horizontal direction and a lenticular lens in which cylindrical lenses being long in the horizontal direction and having an optical power only in the vertical direction are arranged at predetermined
15 intervals in the vertical direction.

14. The stereoscopic image display method according to Claim 1, wherein said second optical system is a microlens array in which toroidal lenses
20 having a focal length in the vertical direction and a focal length in the horizontal direction different from each other are arranged in a predetermined period in the horizontal direction and in a predetermined period in the vertical direction.

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15. A stereoscopic image display method with an image display element and a mask member having a mask

pattern with predetermined openings and shields,
wherein directing of image display light from said
image display element is effected by a first optical
system and a second optical system placed before and
5 after said mask pattern.

16. A stereoscopic image apparatus using the
stereoscopic image display method as set forth in
either one of Claims 1 to 15.